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CONTEXT STABILITY IN PREFERENCE FOR FOREST LANDSCAPES

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Abstract

The effect on observer's scenic preferences of an experimental context variable, the proportion of forest landscape scenes viewed which depict recent harvest activity, was examined by obtaining judgements about the scenic beauty of forests represented by color slides. Different observer groups rated the scenic beauty of a set of harvested and unharvested forest scenes presented in different mixes. The proportion of harvested versus unharvested scenes viewed was found to have a small but significant effect on judgements of scenic beauty. This finding suggests that care must be used in assessing scenic beauty to accurately reflect the context to which the assessment is to be generalized.

Context Stability in Preference for Forest Landscapes

In response to strengthened requirements for visual quality assessment and for public involvement in environmental planning, people are increasingly being asked to express their aesthetic judgements and preferences for alternative landscapes. Choices, rankings or ratings of landscape scenes are used to determine public aesthetic preferences. Relationships between public preferences and measured landscape characteristics are studied to form a basis for predicting the aesthetic consequences of environmental change and to guide the formulation and selection of aesthetically sensitive land management strategies. This paper reviews studies that have examined the context stability of preference for forest landscapes and reports on a test of the stability of scenic preference as the mix of observed scenes changes. The test indicates that the beauty of any one scene depends in part on the other scenes viewed.

Two recent reviews (Zube, Sell, and Taylor, 1982; Daniel and Vining, 1983) have noted the increased reliance on public perception as a basis for landscape quality assessment and have identified the "psychophysical approach" as that which systematically relates aesthetic preferences to measured biophysical characteristics of the environment.The psychophysical approach has been applied to both "vista" landscapes, where views are distant and expansive, and to "near-view" scenes, extending

generally for 100 meters or less and evidencing no or very few distant landscape elements. In either case, the landscape is typically represented to observers by color slides or prints. Vista studies have typically related measures of the area or proportion of the two-dimensional photograph covered by various features (e.g., area in green vegetation, proportion of scene covered by water) to observer preferences or judgements of scenic quality (e.g., Shafer, Hamilton, and Schmidt, 1969, Buhyoff and Leuschner, 1978; Buhyoff and Wellman, 1980; Buhyoff, Wellman, and Daniel, 1982). Near-view studies have either used estimates of environmental features based on inspection of color slides (Daniel and Boster, 1976; Arthur, 1977) or have directly inventoried biophysical features on-site (e.g., Klucas and Duncan, 1967; Rutherford and Shafer, 1969; Brush, 1979; Benson and Ullrich, 1981; Schroeder and Daniel, 1981; Schroeder and Brown, 1983; Brown and Daniel, 1984).

Consistent relationships between measured landscape features and public preferences have typically been found in the psychophysical studies, and similar relationships frequently recur across studies. For example, the presence of water and green vegetation are generally positive features in vistas (e.g.; Shafer and Richards, 1969; Buhyoff, et al., 1982) and open stands of large trees are preferred and downed-wood is not preferred in near-view forest scenes (Benson and Ullrich, 1981; Schroeder and Daniel, 1981; Brown and Daniel, 1984). However, detailed

comparisons of psychophysical relationships between studies is hampered by differences in experimental procedures and contexts.

Among the more important differences between studies which have been found to have little effect on study results are: (1) the sample of participants/observers used, (2) the landscape representation medium (slides, prints, or on-site views), and (3) the observers' response format. Boster and Daniel (1972) and Daniel and Boster (1976) generally found very little difference between the scenic beauty perceptions of separate "general public" groups judging a common set of near-view forest slides. Only groups representing very different viewpoints about forest management (e.g., foresters versus ranchers) differed significantly. Consistency of judgements among different public groups has also been reported by many other investigators (e.g., Shuttleworth, 1980; Anderson, 1982; Kellomaki and Savolainen, 1984; Brown and Daniel, 1984). In addition, Brown and Daniel (1984) and Buhyoff et al. (1982) reported that student volunteer groups were consistent with general public adult groups. Jackson and Hudman (1978) compared responses about scenic quality of forest scenes represented by color slides to similar responses of the scenes represented by color prints, and found little difference in group mean response between the two photographic media. Boster and Daniel (1972), Daniel and Boster (1976), Shuttleworth (1980), and Kellomaki and Savolainen (1984) found little difference in responses to outdoor scenes when viewed on

site or represented by photographs. Comparing response formats, Buhyoff, Leuschner, and Arndt (1980) did not find a significant difference between paired comparison and ranking responses (both converted to interval preference values based on Thurstone's Law of Comparative Judgement) obtained from different groups drawn from the same population. Similarly, Buhyoff et al. (1982, p. 830-831) compared paired comparisons scaled by the Law of Comparative Judgement to rating response scales transformed to "Scenic Beauty Estimates" (SBEs) (Daniel and Boster, 1976) and concluded that "the two methods yield essentially the same metric." Also, concerning the effect of the time respondents choose to take in viewing scenes, Wade (1982) found "no relationship between landscape preference and looking time."

Two aspects of experimental context that have been found potentially significant are the season when photographs are presented for judgements and the labels attached to the scenes. Buhyoff and Wellman (1979) found a significant interaction between the season in which photographs were taken and the season in which they were evaluated. For example, preference for fall foliage was greater in the late summer than spring, while preference for green foliage was greater in spring than late summer. Anderson (1981) found that labels such as "wilderness area" consistently elevated an area's scenic quality ratings while labels such as "commercial timber stand" consistently reduced it.

An additional contextual concern is the effect on observer judgements of the range and relative mix of environmental conditions presented for judgement. An aspect of the context in which any one scene is judged is the set of other scenes that are also presented to the observer. Whether the observer views a set of slides in the course of a landscape quality experiment or directly visits sites on a day's outing, the set of scenes previously viewed determines the context for each scene. If the relative mix of scenes presented in an experiment significantly affects the perceived scenic beauty of individual scenes, then such context effects may limit comparability of experiments, and their generalizability to "real world" landscape experience.

There is scant, and conflicting, evidence regarding the effects of scene mix on judgements. Daniel and Boster (1976, p. 34-35) reported that SBE values for four of six assessed pine forest areas remained unchanged when slides of a strip cut and a clear cut area were replaced by a burned area and a park-like pine stand. Still, they acknowledged that there were limits (untested) to the context stability of SBE measurements. And Brown and Daniel (1984) reported the apparent existence of a scene mix context effect, but did not test for the significance of that effect.

The studies reported below assessed the effects of scene mix changes on observers' judgements of the scenic quality of forest

landscapes. Scene mix was manipulated by varying the proportion of forest scenes that evidenced recent selective harvest and management activities. "Treated" areas showed reduced stand density, disturbed ground, or increased volumes of slash (unused branches or tree tops left scattered or piled on the ground following timber harvest). Finding that the relative proportion of treated verses untreated scenes shown to subjects does not significantly affect their scenic beauty judgements would suggest that considerable freedom may be exercised in assessing observer's scenic beauty preferences. However, finding that scene mix significantly affects judgements would suggest, at least for the type of environments shown in this study, that the experimental scene mix should represent the real world conditions being assessed, and that care should be exercised in comparing experimental results obtained from different scene mixes.

Method

Color slides of treated and untreated forest areas were shown to observers in either a separate or a mixed context. In the separate context each observer viewed and judged slides of treated or of untreated scenes, while observers in the mixed context judged equal numbers of treated and untreated scenes randomly interspersed. Every scene was judged in both separate and mixed contexts, so there were four observation conditions: separate-treated, separate-untreated, and two mixed conditions of different halves of the treated and untreated area scenes. Each

of the four conditions was presented to a separate observer panel. This basic design was followed for two different forest areas, one a relatively flat and open ponderosa pine forest and the other a steeper and more dense mixed conifer forest. Both areas are on national forest land in northern Arizona. In addition, to increase confidence in the results, the entire experiment was repeated one year later, yielding two independent tests of the context effect for each area. Applying the basic design twice for each of the two areas required 16 observer panels in all.

Representation of Conditions

At the ponderosa pine site a longitudinal design was employed; the same sites were photographed before any treatment (summer 1979) and again after treatment (summer of 1980 or 1981).[1] The treatment removed approximately 40 percent of the overstory. A large number of photo points were located and permanently marked along random transects as part of a larger study of the area (Brown and Daniel, 1984). Four color slides (Kodachrome 64) were taken at each sample point in randomly selected compass directions. For the present study 30 of these sample points were randomly sampled, with the restriction that at least two of the four post-treatment (1980-1981) slides showed evidence of management activity (e.g., slash, stumps, disturbed ground). The other two slides at each point generally showed some evidence of treatment though in some instances this was rather subtle. For the 1980 slides slash was mostly scattered, but by the 1981 sample

it had been collected into piles that were relatively uniformly scattered through the study area. Thus the 120 untreated slides (four at each of the 30 points) showed no evidence of recent management action, and most of the 120 treated slides showed some or substantial evidence of recent management,

The second study area was composed of two "matched" mixed conifer watersheds.[2] Each watershed had over 100 permanently marked points (inventory plot centers) arranged in an even grid pattern, at which 4 photos had been taken in the summer of 1982. One of the watersheds was harvested over the period 1978 to 1980, with slash being piled and burned over half of the area and cut and scattered over the remainder. The other, "control" watershed was left undisturbed. For the present study color slides from 30 points (4 photos per point) were sampled from each watershed. Because evidence of the harvest activities was generally less noticeable than at the pine study area, due to different harvest and slash treatment procedures and the two-to-four years of post-harvest recovery, less stringent criteria for sample point selection were applied than with the pine area. Points sampled for the treated condition (harvested watershed) were required to have at least one of the four photos showing clear evidence of management activity; the other three tended to show some, or in many cases no, evidence of treatment. Points for the untreated condition were sampled from the control watershed, and were required to approximately match treated points in slope and aspect.

The two mixed conifer watersheds were chosen to match as closely as possible on many environmental dimensions. However, because different sites (rather than the same sites photographed at different times) provided the treated-untreated manipulation in the mixed conifer area, there were differences in both biophysical and visual characteristics between experimental conditions not directly related to management effects. Futhermore, evidence of management activities was generally more subtle in the mixed conifer area than in the pine area. Still, the mixed-conifer area provided a complementary test of separate versus mixed context effects and an indication of their robustness.

Observers

Presentation of separate-treated, separate-untreated, and the two mixed conditions required four panels of observers for each replication of the study for each study area. Volunteers from undergraduate classes at the University of Arizona participated in the study in response to posted solicitations. Panels ranged in size from 20 to 32 observers, with no restrictions on group composition. Both males and females, and a range of ages typical of university undergraduates, were informally observed to be represented in each group. Normal or corrected-normal vision was stated as a condition for participation, but no assessment of visual acuity was administered. Observer records that were illegible or incomplete (missing more than 2 of the 145 required responses) were rejected from the study. For all panels, at least 20 observers met these criteria.

Slide Sets

Each panel was required to judge 145 slides depicting either the ponderosa pine or mixed conifer forest scenes. In addition to the 120 treated, untreated, or mixed slides unique to each panel, a common set of 25 "baseline" slides (of untreated pine or mixed conifer forests) was interspersed; responses to the baseline slide set established the origin of each panel's SBEs. Thus, for each replication of each area the 120 treated and the 120 untreated scenes were shown twice, once in the separate and once in the mixed context, and the 25 baseline slides were shown four times, twice in the separate and twice in the mixed context. In all cases slides were randomly ordered with the restriction that a baseline slide appeared in every fourth position.

Ratings

Separate panels of observers viewed each of the 145 slides appropriate to their experimental condition and independently rated the "scenic beauty" of each. Ratings were recorded on a 10-point scale extending from "very low scenic beauty" (1) to "very high scenic beauty" (10). Prior to rating the experimental slides, a set of 10 "preview" slides depicting the range of either pine or mixed conifer scenes that were to be judged were shown to help observers establish anchors for the rating scale. Then the study slides were shown sequentially and observers were given 8 seconds to observe and record their rating of each slide. The ratings from each panel were scaled using the "by slide" Scenic

Beauty Estimation procedure reported by Daniel and Boster (1976) and used in numerous studies of the scenic beauty of outdoor environments (e.g., Arthur, 1977; Anderson, 1981; Buhyoff et al., 1982; Vining et al., 1984). The method yields standardized interval-scale estimates of perceived scenic beauty (SBEs) for each scene. A thorough discussion of this procedure can be found in Hull, Buhyoff, and Daniel (1984).

Design

The ponderosa pine and mixed conifer data were separately subjected to analysis of variance. Each analysis was therefore based on the responses of eight separate panels, four from each replication of the experiment. SBE was the dependent variable. The observer factor was collapsed into the SBE scores for each slide, which utilized all the ratings from a given panel in generating a score for each scene. For each analysis of variance, slide presentation context (2 levels), the treatment factor (2 levels), and the replication factor (2 levels) were crossed. For the ponderosa pine analysis, where the same points were sampled before and after treatment, photo point (30 levels) was crossed with context, treatment, and replication, and slides (4 levels) were nested within points. For the mixed conifer analysis, where separate pre- and post- treatment areas were sampled, points were nested within treatments, and slides were nested within treatment-by-point combinations. Context and treatment factors were fixed, and point and slide factors were considered random.

Results

Reliability

Psychophysical studies to date have all utilized composite (group), as opposed to individual observer, measures of landscape quality. This trend is likely to continue because the principal objective in all such studies is to learn about an interest group's or the general public's preferences. This study also utilizes the composite scenic preference scores (SBEs) of observer panels. Thus, group-to-group reliability is of primary interest.

Two measures of group-to-group reliability are presented. First, the intraclass correlation coefficient for rating data (Ebel 1951) of the composite ratings per slide indicates the internal reliability of a panel's ratings. One coefficient was obtained for each observer panel. This measure varied from .85 to .93 for the eight ponderosa pine panels and from .81 to .91 for the eight mixed conifer panels, indicating that SBEs obtained from other subject panels seeing the same slides in the same contexts would correlate at close to .9 with those obtained for this study.[3]

The second measure of reliability was obtained by comparing SBEs of the first replication with those from the second replication. The correlation of one panel's SBEs with the SBEs obtained from another panel that saw the same slides in the same context should also indicate group-to-group reliability. For the ponderosa pine area, Pearson product moment correlations ranged

from .82 to .87 for the four pairs of panels, while for the mixed conifer area they ranged from .76 to .85. These correlations are slightly lower than the intraclass correlation coefficients. The drop may be the result of a change in personnel administering the experiment and other minor setting differences between the original administration of the study and its replication one year later.

Analysis of Variance

The analyses of variance on SBE scores showed that the context-by-treatment interaction was a significant source of variance for both study areas. Treatment and context factors were significant as main effects only for the ponderosa pine area. Also, as expected, factors representing inventory points and slides within points accounted for the bulk of the variance in both analyses.

Treatment of the ponderosa pine area significantly affected scenic beauty, $F(1,29) = 25.58$, $p < .0001$, and accounted for 13 percent of the total variance. Combining responses from both contexts, SBE averaged 20 before treatment and -11 after treatment. Although context accounted for only 1 percent of the variance, it was also significant $F(1,29) = 26.93$, $p < .0001$. Combining across treatments, SBE averaged 1 in the separate and 7 in the mixed context. Of principal interest to the study was the treatment-by-context interaction shown in Figure 1. The evident convergence of SBEs in the mixed condition for treated and

untreated scenes was significant, $F(1,29) = 74.34$, $p < .0001$, although it only accounted for 2 percent of the total variance.

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Insert Figure 1 about here

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While the three-way replication-by-treatment-by-context interaction was also significant, $F(1,29) = 6.00$, $p = .0200$, the effect was small in magnitude, and separate analyses for the original experiment and the replication showed that the treatment-by-context interaction was significant in each case, $F(1,29) = 76.90$, $p < .0001$ and $F(1,29) = 15.37$, $p = .0005$, respectively.

In the mixed conifer analysis, the context-by-treatment interaction was also significant, $F(1,58) = 18.40 =$, $p = .0001$, and accounted for 1 percent of the variance. Contrary to the ponderosa pine analysis, the treated area was preferred to the untreated area (Figure 1). As in the ponderosa pine analysis, moving from the separate to the mixed context caused a convergence in the SBEs of the treatments. However, moving from the separate to the mixed context appeared to have little or no overall effect on SBE of treated scenes in the original experiment, while the move decreased treatment SBEs in the replication. The three-way replication-by-treatment-by-context interaction was not significant in the mixed conifer analysis, and separate analyses showed that the treatment-by-context interaction was significant

in both the original experiment, $F(1,58) = 4.91$, $p = .0306$, and the replication, $F(1,58) = 22.29$, $p < .0001$.

The impact on SBE of the context change is depicted for the first replication of the ponderosa pine experiment in Figure 2 where SBEs of the 30 photo points are presented in ranked order based on separate context responses.

Insert Figure 2 about here

For both treatment conditions, SBEs differ by context, and reversals in rankings of photo points are common. However, while the difference in SBEs across contexts is persistant, it is not large in magnitude. For the untreated condition, the Pearson product moment correlation of SBEs obtained in the separate context with those obtained in the mixed context was .82 in the original experiment and .84 in the replication experiment. For the treated condition, the correlations were .72 and .74, respectively. Thus, the general trend is for relative differences among SBEs to be quite similar in both the separate and mixed contexts.

To summarize, in both study areas the context-by-treatment factor was significant, confirming that the relative proportion of treated verses untreated scenes shown to observers affects their scenic beauty judgements. The effect of the context change was

small, but also consistent, across two replications in two different study areas.

Discussion

In this study, two different kinds of "treatment" effects were examined. In the ponderosa pine case, the "treatment" was selective harvest and slash manipulation of one area, while in the mixed conifer case it was the difference between two adjacent watersheds, one of which had been changed by selective harvest and slash treatment. In both the ponderosa pine and mixed conifer areas, slide presentation context significantly affected perceived scenic beauty (SBE). In each area, presenting scenes in the mixed context reduced the difference in SBE between the treatments by increasing SBE of the less scenic (as determined in the separate context) treatment and (in all but one replication) decreasing SBE of the more scenic treatment. Results suggested that the more conspicuous treatment difference (the ponderosa pine area) resulted in a larger context effect.

Context could be manipulated in a number of different ways. For example, scenes from different forest types might be mixed, or summer and fall scenes from a deciduous forest might be mixed. As this study shows, the mixing may produce different scenic judgements than would be obtained if each class of scenes were presented separately. The magnitude of the context effect would most likely vary with the degree of difference between classes of scenes. At one extreme, the context effect would, of course, be

expected to disappear as the difference between classes of scenes became small enough. In the present study, the harvest treatment effects were rather subtle (for most photo points only 1 or 2 of the 4 photos showed obvious evidence of treatment). A more obvious difference between treatments might have produced a greater context effect. However, at the other extreme, there is probably a limit to the difference between treatments which would cause a context effect. Mixing slides of starkly different classes of scenes, such as forests and city streets, may (aside from confusing observers) fail to produce context effects because the criteria used to evaluate one class might be quite separate from and unaffected by the criteria used to evaluate the other class.

The context effect may also vary with changes in the proportion of scenes of each class included in a presentation. Only separate and one mix were examined in this study. It is plausible to expect the effect on SBE to vary depending upon the particular proportion of scenes representing each treatment.

One cause of the context effect may be cueing by observers on different biophysical features present or absent in the scenes. Evidence of cueing has been found in other studies. For example, Buhyoff and Leuschner (1978) and Buhyoff and Riesenman (1979) found indication of cueing when they showed the same forest vistas of beetle-damaged forest to groups of observers, some of whom were informed of the presence of the damage. The proportion of forest

area in damage explained from 83 to 86 percent of the variance in preference scores for the informed groups, but only from 27 to 38 percent for the uninformed groups (Buhyoff and Leuschner 1978). This suggests that the informed subjects used a "damage criterion" (Buhyoff and Riesenman 1979, p. 234) in specifying preference, or in other words that they more heavily cued on damage than the uninformed groups. On the other hand, Buhyoff and Riesenman (1979, p. 235) hypothesized that observers of the uninformed groups used a "multidimensional routine" in determining their preferences.

In this study all observers were given consistent information about the specific nature of the scenes to be rated. However, a change in the proportion of slides showing distinct features might also affect cueing. For example, an increase in the proportion of scenes with heavy volumes of downed wood may encourage selection of downed wood abundance as a criterion on which to judge all scenes. Brown and Daniel (1984) found evidence that observers used a multidimensional set of criteria in judging scenic beauty and that the relative proportion of scenes exhibiting different forest characteristics affected the relative importance of the characteristics as criteria. For example, their data show that, for ponderosa pine basal area (a measure of pine stocking) and herbage weight variables, SBE correlated -.37 and .59 for a set of untreated scenes, and 0.0 and .11 for a mixed set of treated and untreated scenes, respectively. Similarly, for variables

describing the percent of downed wood which was slash and the number of stumps, SBE correlated .11 and -.10 for the untreated set, and -.48 and -.30 for the mixed set, respectively. Observers were apparently cueing more heavily on herbage and pine stocking when only the untreated scenes were presented and more on percent slash and stumps when a mix of treated and untreated scenes was presented.

The presence of a significant slide presentation context effect has implications for scenic beauty assessment, regarding (1) the comparability of different scenic assessments and models and (2) the external validity of scenic beauty research results, i.e., the extent to which they may be generalized to "real world" conditions. First, the comparability of scenic assessments obtained in different slide presentation contexts depends on the magnitude of the effect and the use of the results. The context effect may or may not be of importance in practice. If the desired result of scenic assessment is a simple ranking of forest areas, then the context effect may be of little practical consequence. However, where tradeoffs among forest management alternatives are at issue, changes in relative magnitudes may be consequential even though the ranking of scenes does not change.

Context effects are common in many types of human assessment situations. For example, several studies have shown that people's assessment of their willingness to pay for environmental amenities depends on the experimental context in which they are put (e.g.,

Rowe, d'Arge, and Brookshire, 1980; Schulze, d'Arge, and Brookshire, 1981). Similarly, Lichtenstein and Slovic (1971) have shown that people use different criteria to assess gambles depending on whether they are put in a rating or monetary response mode. There is no general solution to the choice of the most appropriate context to use for any given assessment situation. The choice of the context must be determined on the basis of the goals of the assessment. However, to the extent that the objective of scenic assessment is to better understand and plan for public enjoyment of outdoor scenes, and to the extent that slides are valid surrogates for scenes viewed on site, our results suggest that the assessment context should resemble the actual conditions that the assessment represents, e.g., it should reflect that mix of scenes that observers would encounter on site in the outdoor excursion of interest.

Footnotes

[1] The area was harvested in the early 1950's, but there was little or no evidence of that treatment at the time of the photo sampling in 1979.

[2] The mixed conifer area is called Thomas Creek (see Daniel and Boster, 1976).

[3] These intra class correlation coefficients ignore "between-raters variance" (Ebel 1951) caused by differences in the mean of the different observers' ratings. We assume that the coefficients nevertheless indicate group-to-group reliability, and not just the test-retest reliability for the same obsever panel, of SBEs because the SBE transformation removes observer-to-observer differences in mean rating.

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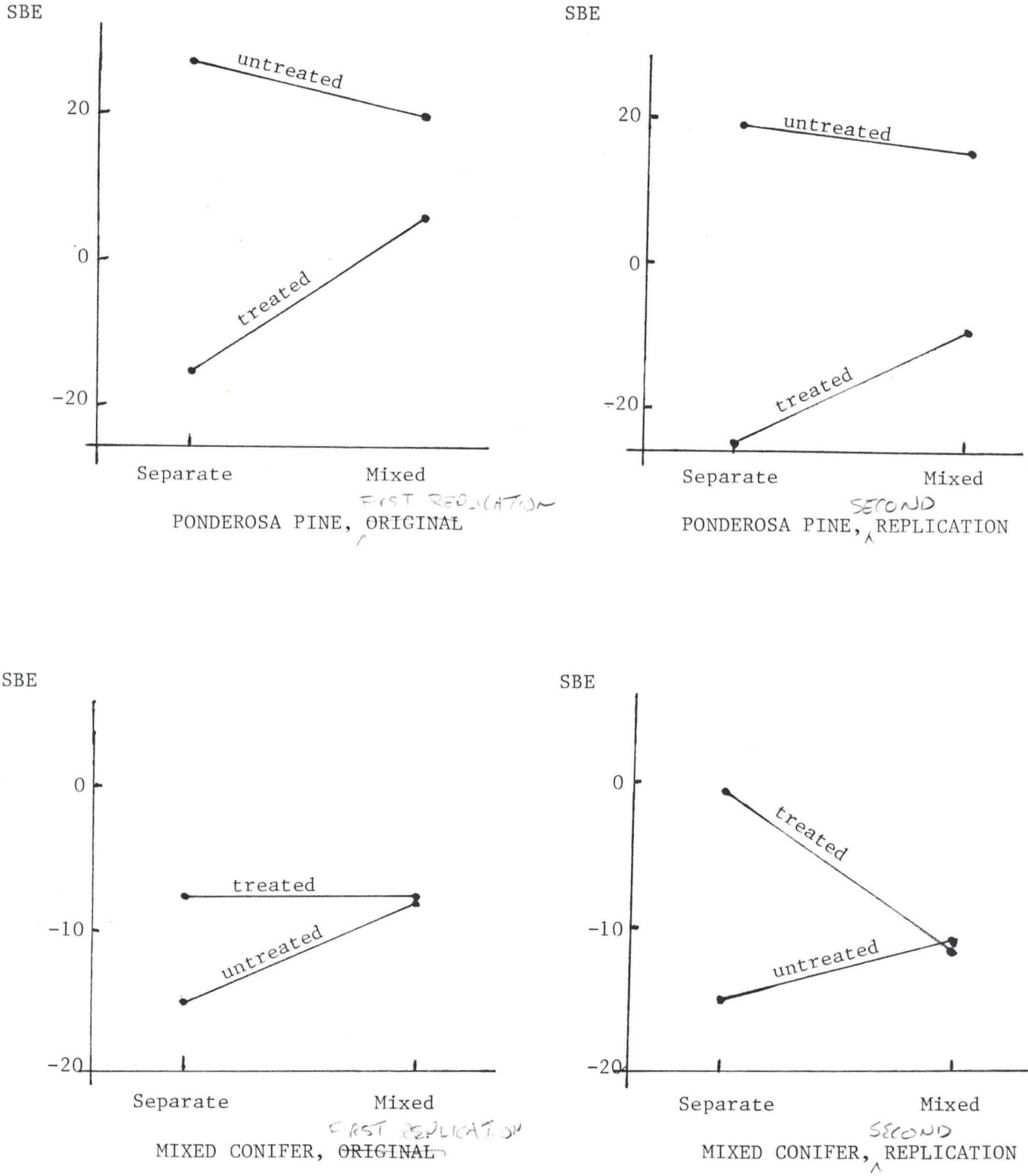
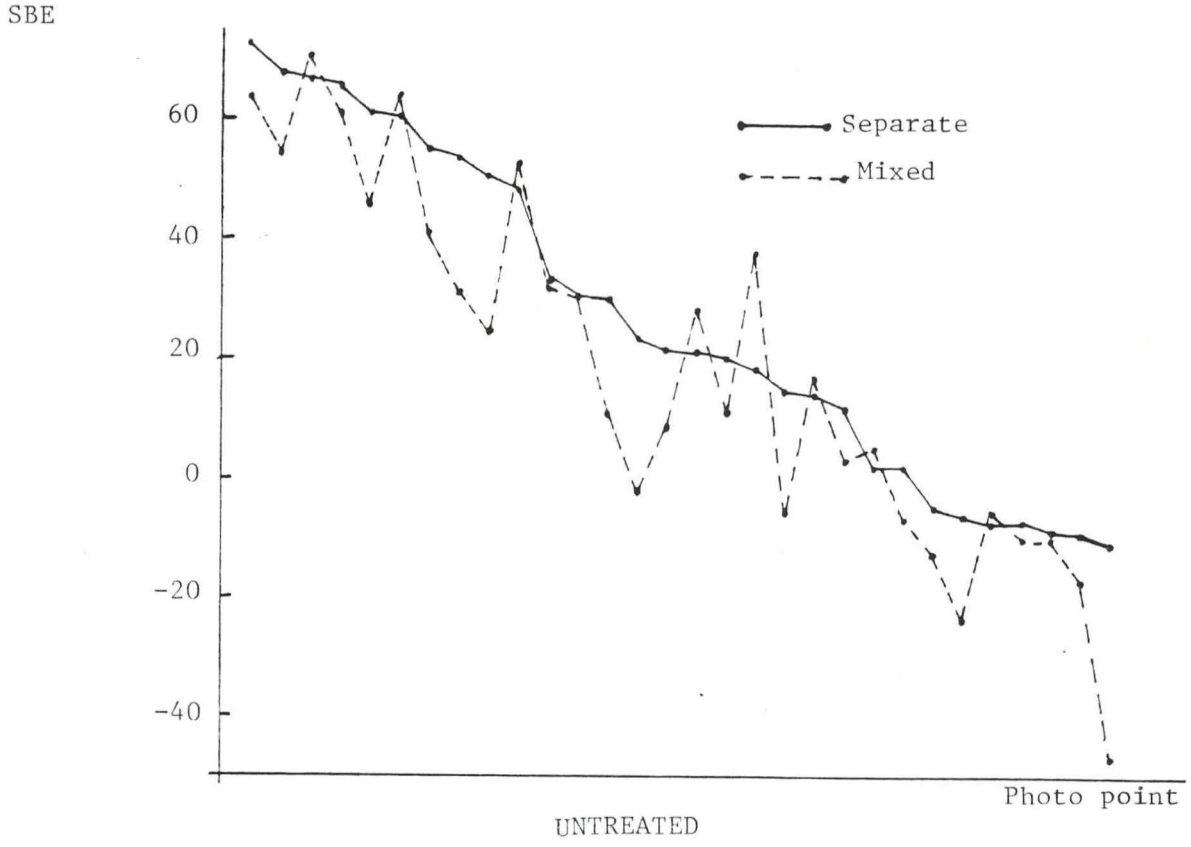


Figure 1. Mean SBE for two forest areas as a function of treatment and slide presentation context.



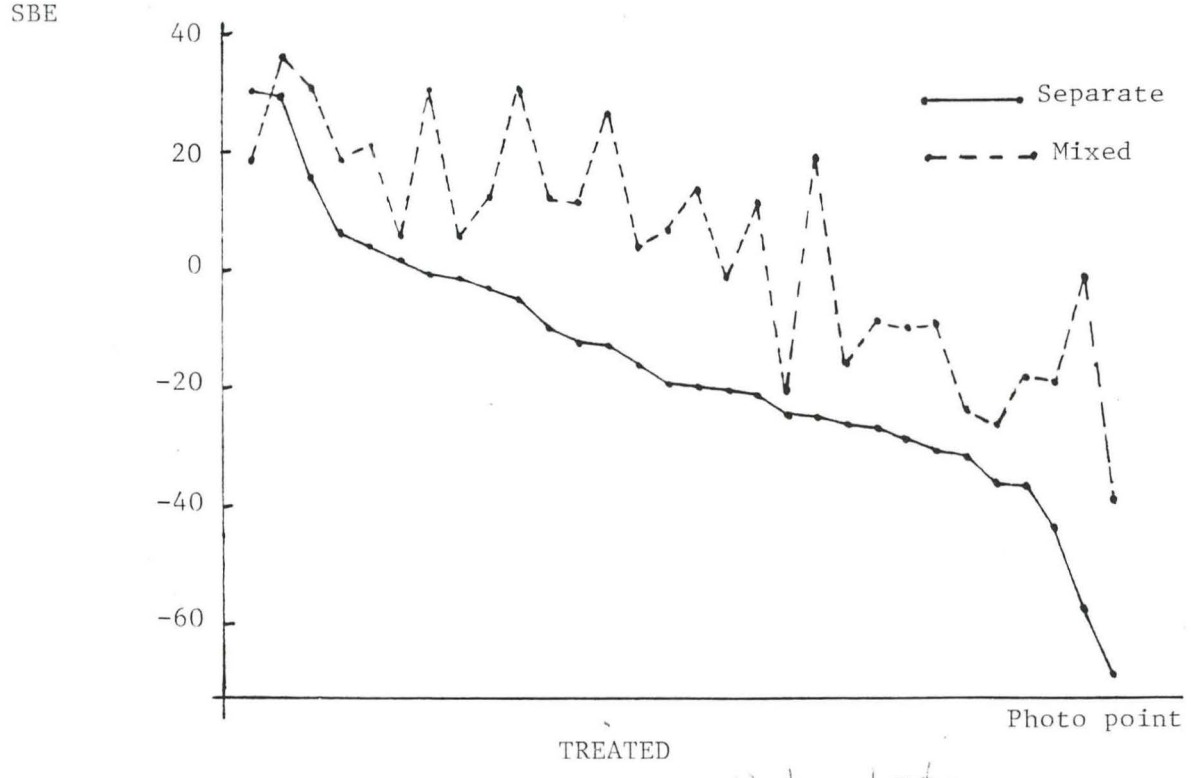


Figure 2. Photo point SBE for ~~original experiment~~ first replication, ponderosa pine area